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Abstract

This study examined how cumulative exposure to racial discrimination and bullying victimization influences the health of Australian adolescents (n=2802) aged 10-11 years (19.3% visible ethnic minorities (non-White, non-Indigenous); 2.6% Indigenous) using data from 3 waves (2010-2014) of the nationally representative Longitudinal Study of Australian Children (LSAC). Cumulative exposure to racial discrimination and bullying victimization had incremental negative effects on socioemotional difficulties. Higher accumulated exposure to both stressors across time was associated with increased BMI z-scores, and risk of overweight/obesity. Studies that examine exposure to single risk factors such as bullying victimization or racial discrimination at 1 time point only are likely to miss key determinants of health for adolescents from stigmatized racial/ethnic backgrounds and under-estimate their stressor burden.

Racial/ethnic discrimination is a common, everyday experience for adolescents from stigmatized racial/ethnic groups throughout the world. The negative impacts of racial/ethnic discrimination on adolescents health are documented in a growing body of empirical literature (Benner 2017; Priest et al. 2013). Yet most studies conducted to date have used cross-sectional data. Less is known about the accumulation of experiences of racial/ethnic discrimination among adolescents over time, and how cumulative exposure to racial discrimination is associated with adolescent health. How racial discrimination is associated with other risk factor exposures for adolescent health is also under-researched, despite wider recognition that the harmful impacts on health from multiple risk factor exposure exceed those from singular exposures, and that a singular risk factor exposure focus is likely to underestimate the capacity of risk factors to influence health (Evans, Li and Whipple 2013). For example, bullying victimization is a common risk factor exposure for negative health outcomes experienced by many adolescents worldwide, yet how bullying victimization and racial discrimination co-occur among adolescents, and their cumulative association on health, is under-researched internationally (Larochette, Murphy and Craig 2010; Priest et al. 2016). Moreover, the majority of work examining the impacts of racial discrimination on adolescent health focuses on socioemotional outcomes, with a much smaller literature examining physical health. It also remains largely focused on the United States with far fewer studies in other contexts (Priest et al. 2013). This current study aims to address these gaps by examining the accumulation of racial discrimination and bullying victimization exposure over time, and how each of these risk factor exposures independently and together influence health, among a population representative sample of Australian adolescents.

BACKGROUND

Accumulation of racial discrimination, bullying victimization, and adolescent health

Lifecourse perspectives emphasize that both early and ongoing socially patterned risks and opportunities lead to health and developmental (dis)advantages (Ben-Schlomo and Kuh 2002). Age and time are considered not only biologically and developmentally significant, but also socially

significant, as individuals exit and enter different contexts for exposure to risks and opportunities (Gee, Walsemann and Brondolo 2012). Attention is thus paid to not only if, but also how long or how often exposures are experienced. Applying lifecourse perspectives to the influence of racism and health, including examination of experiences at different developmental periods and their accumulation over time, is an underaddressed research priority (Gee, Walsemann and Brondolo 2012).

Racial discrimination is conceptualized as unfair treatment due to race, ethnicity, indigenous and/or migrant status and behavioural manifestations of racism, an ideology of inferiority that categorises, stratifies, devalues and disempowers groups considered to be inferior and differentially allocates to them valued opportunities and resources within society (Feagin 2006; Williams 2004). The integrative model for minority youth (Garcia Coll et al. 1996). The need to consider racial discrimination within the context of other stressor exposures is also considered a priority (Lewis, Cogburn and Williams 2015).

One important such risk factor exposure for adolescents is bullying victimization. Bullying victimization is defined as a type of proactive aggression characterized by an imbalance in power between perpetrator and victim, and typically involves repeated experiences (Olweus 1993). Critical differences between these two related, yet distinct risk factor exposures are outlined in the developmental intergroup framework (Killen, Mulvey and Hitti 2013). This framework considers racial discrimination to be related primarily to group membership and social identities related to race, ethnicity, culture and nationality, functioning to maintain status differences between groups present within wider society; in contrast, bullying victimization occurs at an interpersonal level as peer rejection related to individual traits and behaviours (Killen, Mulvey and Hitti 2013). Accounting for both intergroup exclusion and interpersonal rejection is considered essential to understanding influences on child development (Killen, Mulvey and Hitti 2013). Empirical research shows

awareness of racial stereotypes and out-group biases emerge in middle childhood (Aboud and Amato 2001) and that by age 10 children recognize discriminatory acts (McKown and Weinstein 2003) suggesting children at this age are able to differentiate bullying from racial discrimination.

Accumulation of racial discrimination over time

Relatively few studies have examined patterns of accumulation of racial discrimination over time and how these influence healthy adolescent development, with such knowledge also limited among adult populations (Gee, Walsemann and Brondolo 2012; Wallace, Nazroo and Becares 2016). Life course theory (Ben-Schlomo and Kuh 2002) and developmental science (Bronfenbrenner and Evans 2000) both consider duration and accumulation of risk factor exposure core to understanding health and recognize repeated exposure exceeds the detrimental impact of single exposures (Evans, Li and Whipple 2013). As a result, studies that focus on racial discrimination as single, episodic experiences may well under-estimate the effects on individual health of racial discrimination (Wallace, Nazroo and Becares 2016). Like other chronic stressors, experiences of racial discrimination are likely to have cumulative effects (National Research Council 2004). Cross-sectional measures also assume racial discrimination is static rather dynamic over time (Gee, Walsemann and Brondolo 2012), as is recognised for other fundamental causes of health inequalities such as socioeconomic position (Sheehan et al. 2017). Similarly, peer victimization is often characterised as a stable experience despite varying by time and age (Hymel and Swearer 2015), with prospective studies to allow identification of exposure patterns over time, and their effects, recommended (McDougall and Vaillancourt 2015).

Extant literature documents dose-response associations between accumulation of exposure to racial discrimination experiences and poor health in cross-sectional studies (Brondolo et al. 2009; Williams and Mohammed 2009), and emerging evidence is beginning to show the importance of cumulative exposure to racial discrimination on health using longitudinal designs with repeated measures of

discrimination (Wallace, Nazroo and Becares 2016). One study among ethnic minority adults in the UK found cumulative exposure to racial discrimination over time and across domains had incremental negative long-term effects on mental health (Wallace, Nazroo and Becares 2016). Another recent study among older US women found that women who had experienced cumulative perceived interpersonal discrimination over time, and across attributions and domains, had the highest risk of depression compared to women who had experienced minimal or no discrimination (Bécares and Zhang 2018). Another study among two cohorts of African American youth found distinct groups characterized by different levels of exposure to racial discrimination from ages 16-18 years, with high and stable levels of racial discrimination over this period associated with higher epigenetic-aging scores at age 22 among those with low support in their family environment, but not for those with low and stable or low and increasing levels of racial discrimination (Brody et al. 2016). Analysis using one of these same cohorts found high and stable levels of racial discrimination aross ages 16-18 was associated with increased allostatic load at age 20 only for youth without high emotional support (Brody et al. 2014). Another study using the other of the cohorts averaged scores of experiences of racial discrimination across ages 17-19 years and found that levels of racial discrimination experiences were stable over time, with high levels of racial discrimination were associated with elevated cytokine levels three years later (Brody et al. 2015). While this study does capture experiences of racial discrimination experiences over time, averaging experiences across multiple years precludes detailed understanding of how cumulative experiences over time are patterned, and how they are associated with subsequent health outcomes. In contrast, another recent study among adolescents in the US found racial discrimination experiences in adolescence beginning in the 8th grade and early adulthood, and cumulative exposure across both these periods were all similarly related to diurnal cortisol profiles (Adam et al. 2015). These few existing studies examining health effects of accumulated racial discrimination are all among African American youth, predominantly older adolescents; use small community-based data; and examine biomarkers of risk rather than observable health outcomes. Whether these findings are observed at younger ages, across

ethnic groups and contexts, using population-level data and if biomarker effects are also present for observable mental and physical health outcomes are critical questions addressed by this present study.

Accumulation and co-occurrence of racial discrimination and bullying victimization

Examination of how exposure to racial discrimination is associated with exposure to other risk factors for adolescent health is a further gap addressed by this present study. There is increasing recognition of the need to assess other psychosocial stressors related to social disadvantage when examining how racial discrimination impacts on health (Lewis, Cogburn and Williams 2015). This is supported by accumulation of risk frameworks recognizing that not only do the developmental harms of repeated exposure to the same risk factor exceed those of singular exposure, but so do the harms arising from multiple risk factor exposure, and that multiple risks often co-occur and cluster together (Evans, Li and Whipple 2013).

Bullying victimization is a common risk factor exposure for negative health outcomes reported by a third of youth internationally (World Health Organization 2012). Bullying victimization impacts include increased childhood mental illness and somatic problems (Wolke and Lereya 2015); increased systemic inflammation (Copeland et al. 2014); anxiety, depression, self-harm and overall mental health problems among young adults (Lereya et al. 2015); and in adulthood, inflammation and obesity (Takizawa et al. 2015), anxiety, depression, psychological distress and suicidality (Ford et al. 2017; Takizawa, Maughan and Arseneault 2014). Yet globally, research on bullying victimization and racial discrimination and their respective impacts on health has proceeded independently with little known about the co-occurrence of bullying victimization and racial discrimination, and their cumulative influences on health (Larochette, Murphy and Craig 2010; Priest et al. 2016).

Extant studies find poor to moderate correlations between self-reported bullying victimization and racial discrimination experiences among children and adolescents in Canada (Larochette, Murphy

and Craig 2010) and Australia (Priest et al. 2016). Such differentiation between bullying victimization and racial discrimination is consistent with a developmental intergroup framework that considers interpersonal victimization and intergroup exclusion as distinct, but related exposures (Killen, Mulvey and Hitti 2013). It is plausible that each of these types of stress exposures may have different patterns of association with health outcomes. It is also likely that the additional burden of racial discrimination together with bullying victimization leads to poorer health although patterns and processes remain under-explored. Further examination of cumulative exposure and co-occurrence of bullying victimization and racial discrimination experiences among children and adolescents, and impacts on health, is therefore needed.

Impacts of bullying victimization and racial discrimination on adolescent socioemotional and physical health

While a considerable and increasing research base exists on the consequences of discrimination for adolescent health, the majority of this work focuses on socioemotional development with a much smaller literature exploring impacts on adolescent physical health and chronic disease indicators (Priest et al. 2013). More broadly, considerable evidence documents the impacts of cumulative stress and adversity in childhood and adolescence on cardiovascular and metabolic disease risk factors, including inflammation (Takizawa et al. 2015), body mass index (Barboza Solísa et al. 2015), and overweight and obesity (Danese and Tan 2014). A growing body of work identifies the negative impacts of racial discrimination on cardiovascular disease and chronic disease indicators among adults (Lewis, Cogburn and Williams 2015; Paradies et al. 2015) yet far fewer studies have examined these outcomes among younger populations. One small cross-sectional study found experiences of racial discrimination associated with markers of cardiovascular risk among African American youth aged 10-15 years (Goosby et al. 2015). Internalized racism measured at one time point has also been associated with metabolic risk among Caribbean African adolescent girls aged 14-16 years (Chambers et al. 2004). As cited earlier, several studies have examined impacts of accumulated racial

discrimination during late adolescence on biomarkers of chronic inflammation, biological aging, and physiological dysregulation in early adulthood (Brody et al. 2016; Brody et al. 2015; Brody et al. 2014). Overweight and obesity increase susceptibility to chronic diseases such as type 2 diabetes, cancer, and cardiovascular diease and are most commonly and reliably assessed by Body Mass Index (BMI), including in population monitoring studies (Freedman and Sherry 2009). An association between exposure to racial discrimination and BMI has been shown in UK adolescents (Kelly, Becares and Nazroo 2013). Conceptually, overweight and obesity is associated with racial discrimination through structural processes such as reduced access to healthy food, safe neighborhoods and physical activity promoting resources; behavioral responses to stressor exposure such as disengagement from healthy eating and exercise, increased sedentary behavior; and biological stress responses (Elsenburg et al. 2017; Priest et al. 2013).

To our knowledge no studies have examined the cumulative *combined* impact of adolescent experiences of racial discrimination and bullying, over time and across risk factors, on both socioemotional development and overweight and obesity. Such work is needed given the importance of adolescent physical health for lifelong outcomes, including via impacts on academic, employment, socioemotional, and social outcomes, and with overweight and obesity key risk factors for later chronic disease morbidity and mortality.

Diverse contexts and populations

Finally, most studies of perceived racial discrimination and consequences for adolescent health have been conducted among minority youth in the United States with work on these issues more emergent in other national contexts including Australia (Priest et al. 2013), the UK (Becares, Nazroo and Kelly 2015) and New Zealand (Paine et al. 2018). While often compared and considered similar to the United States, Australia has many marked differences including population size, histories of colonization, diversity among Indigenous groups, slavery, timing of

migration, main countries of migrant origin, and social policy and public discourse regarding race, race-relations and immigration (Reitz, Zhang and Kawkins 2011). Investigating patterns and impacts of discrimination on adolescent outcomes in different countries with variation in social, historical and economic factors can assist in the identification of pathways to positive and negative outcomes for ethnic minority groups and assist in elucidating generalisability of findings across contexts and populations (Zilanawala, Bécares and Benner 2019).

Aboriginal and Torres Strait Islander peoples make up 3.3% of the total Australian population (Australian Bureau of Statistics 2017). Australia also has a rapidly growing migrant population, with more than a quarter of the population born overseas, a higher proportion than the United States, Canada, or New Zealand. Most migrants are from Europe and Asia, though migration from the Middle East and Africa is increasing. Australian administrative data routinely collects an Indigenous identifier, but it does not record self-reported race and ethnicity. In this context, several studies have examined impacts of racial discrimination on Aboriginal youth mental health and suicide risk (Priest et al. 2011 ; Priest et al. 2011) and on depressive symptoms and loneliness among school students from migrant backgrounds (Priest et al. 2014; Priest et al. 2017). Limitations of these studies to date are their relatively small non-representative samples, and with one exception (Priest et al. 2017) cross-sectional designs.

This study aimed to address gaps in the literature described above and examine the associations between cumulative exposure to racial discrimination and bullying victimization with socioemotional development, BMI, and weight status of adolescents in Australia. The following research questions were asked:

> What are the patterns of cumulative exposure to bullying victimization and racial discrimination, separately and combined, among Australian adolescents across Indigenous and ethnic background?

What is the impact of cumulative exposure to bullying victimization and racial discrimination on social and emotional development, BMI z-score and overweight/obesity among Australian adolescents?

It was hypothesised that i) each of the stressor exposures (bullying victimization and racial discrimination) would be independently associated with increased socioemotional difficulties, BMI z-score and risk of overweight/obesity. Following accumulated risk models it was hypothesised that ii) greater levels of each stressor exposure would be associated with poorer outcomes and that iii) cumulative exposure to both stressors over time would be associated with incrementally poorer outcomes compared to single stressor exposure.

DATA AND METHODS

The study uses data from 3 waves of the Longitudinal Study of Australian Children (LSAC). The nationally representative cohort study commenced in 2004 and has been repeated biennially. There are two LSAC cohorts: 5107 children aged 3-19 months (Birth or 'B' Cohort), and 4983 children aged 4 years 3 months to 5 years and seven months (Kindergarten or 'K' Cohort). This analysis focused on the K Cohort , who were aged 10-11 in Wave 4, 12-13 years in Wave 5, and 14-15 years in Wave 6 (see Table 1). The sampling frame was the Medicare Australia database which has near complete coverage of Australian residents (Soloff, Lawrence and Johnstone 2005). At Wave (W) 6 71% of the K Cohort sample remained in the study; n=3409 children were present in all three waves (W4-6), with n=1474 (31.6%) of W1 sample (n=4983) not participating in Waves 4-6 (Norton and Monahan 2015). The Australian Bureau of Statistics (ABS) developed longitudinal survey weights to account for non-response bias due to drop out and to adjust the sample to be representative of the population (Norton and Monahan 2015). Full details are documented elsewhere (Norton and Monahan 2015) but in brief, this occurred in two stages. First, response propensity modelling adjustment was applied to correct for attrition and adjust for differential non-response by particular

demographic groups, including those from ethnic minorities and from low socioeconomic backgrounds.. Then stratum adjustment was applied to re-align weight totals to the known totals from the original W1 sample. Both of these processes contribute to reducing non-response bias. These weights were used in this study. Full weighted sample characteristics are shown in Table 1.

<Insert Table 1 about here>

Dependent Variables

Our focus was on socioemotional and physical health. Socioemotional difficulties were measured at W4 and W6 using the "total difficulties score" from the parent-reported Strengths and Difficulties Questionnaire (SDQ) (Goodman and Goodman 2009). Scores range from 0 to 40 with higher scores indicating more problems. The parent-report SDQ is shown to be psychometrically sound in Australian child and youth populations (Hawes and Dadds 2004) with the SDQ the most widely used measure of youth mental health Australia (Seward et al. 2018). Physical health was measured using body mass index (BMI) calculated as weight/height squared (kg/m^2). At W4 and W6 trained interviewers measured children's weight to the nearest 50g and height to the nearest 0.1cm (Wake and Maguire 2011). BMI z-scores were standardized for age and gender based on age and sex-specific cutpoints defined by the International Obesity Taskforce (IOTF) and Cole cutpoints (Cole et al. 2000). A binary variable using these standardized BMI z-scores was created to classify respondents as 'overweight and obese', or 'not overweight and obese' for ease of interpretability; this was modelled separately from BMI z-score.

Stressor exposure – bullying victimization and racial discrimination

Two cross-sectional summary variables were created for each stressor exposure (bullying victimization and racial discrimination). These were binary and identified whether the respondent had experienced any form of each respective stressor exposure at Wave 5 and Wave 6.

A longitudinal summary variable for each stressor exposure was also created that indicated whether the respondent reported any experiences of the stressor at 1 time point or at 2 time points in order to measure cumulative experiences of each stressor exposure across time. Categories included no experience of the stressor; experience of the stressor at 1 time point (either W5 or W6); and experiences of the stressor at 2 time points (W5 and W6) as used in similar studies (Wallace, Nazroo and Becares 2016).

Specifically, for bullying victimization, in W5, when they were 12-13, children were asked about their experiences of seven types of bullying victimization in the past month (30 days) at school. Items were drawn from the School Climate Bullying Scale (Cornell 2011) and the Edinburgh Study of Youth Transitions and Crime (Smith et al. 2001) and modified slightly for Australia (Ford et al. 2017). See Appendix One for details. Response categories were: never, once or twice, about once a week, several times a week, and were dichotomized into 0: never and 1: once or more (any bullying victimization). In W6, when they were 14-15 years, children were asked a similar, but expanded, set of questions about 13 types of bullying victimization in the past (30 days). Response options were: yes, no, and were dichotomized into: 0: never (none) and 1: once or more (any bullying victimization).

For racial discrimination, in both W5 and W6, children were asked whether, in the last 6 months they had been treated unfairly or badly because of their: language or accent; skin color; cultural background. This study first measured racial discrimination at W5. These measures are consistent with those used internationally (Grollman and Hagiwara 2017) and in Australia among this age-group (Priest et al. 2013). Response categories were: yes, no, and were dichotomized into 0: never (no experience of racial discrimination), and 1: once or more (any experience of racial discrimination).

A summary variable that combined exposure to both domains of stress exposure across time was also created. This was summarised into seven-categories:

1. No experience of racial discrimination or bullying at either wave
2. Racial discrimination or bullying (not both) at one time point (either W5 or W6)
3. Racial discrimination and bullying at one time point (no experience at the other time point)
4. Bullying at both time points, no experience of racial discrimination
5. Racial discrimination at both time points, no experience of bullying
6. Racial discrimination and bullying at one time point, one (either discrimination or bullying) at other time point.
7. Racial discrimination and bullying at both time points

Due to very small numbers in category 5 (n<10) this was combined with category 4 in analysis.

A 16-category summary variable was also created across each possible combination of stressor exposure and time point however due to very small numbers in a number of categories (11 of the categories each with <5% of sample) further multivariable analysis using this variable was not possible.

Covariates

Self-reported race and ethnicity is not routinely collected in Australia, nor are these concepts part of common vernacular. While we acknowledge that immigrant status is not synonymous with race or ethnicity, in Australia various combinations of 'country of birth' and 'language spoken at home' categories are widely used as proxies for self-reported ethnicity or race (Priest et al. 2017). Following previous approaches (Priest et al. 2016) proxy ethnicity categories that identify stigmatized identities based on parental country of birth and Indigenous status were created: Australian-born; Anglo/European (Caucasian or White); visible minority (non-Caucasian or non-White, not Indigenous); or Indigenous (Aboriginal and/or Torres Strait Islander) (Statistics Canada 2009).

Factors thought to be associated with experience of bullying victimization, racial discrimination, and socioemotional development, BMI, and weight status were considered in analytical models. These included Wave 4 measures of child sex (male, female); household composition (single parent, two parent); parental education (parent 1 has completed year 12, parent 1 has not completed year 12); annual household income in Australian dollars ($1-$41,599; $41,600-$77,999; $78,000-$103,999; $104,000 or more); and area-level disadvantage (quintile 1, 2, 3, 4, 5). Area-level disadvantage was measured using the Index of Relative Socio-Economic Disadvantage (IRSD) (Australian Bureau of Statistics 2012). Characteristics of the analytic sample are available in Appendix 1.

Analyses

Bivariate analyses were used to estimate the prevalence of each of the stressor exposure variables. We restricted our eligible sample to those responents who had participated in all three waves from Waves 4-6, a total of n=3409 respondents. There was a small amount of missing data (<5%) for all the exposures and covariates, except for household income (12%). Missing data on covariates and exposures reduced the analytic sample by 12% (n=607) to n=2802 participants with complete data on all covariates and exposures so complete case analysis was considered satisfactory. Longitudinal survey weights were used to account for non-response and to adjust the sample to be representative of the population (Norton and Monahan 2015).

To examine the burden of each stress exposure (bullying victimization and racial discrimination) on each health outcome in W6 (socioemotional development, BMI z-scores, weight status) a series of multiple regression models were built for each of the three outcomes. First, unadjusted models examined the crude association between each stress exposure and each health outcome. Then models adjusted for prior health status at W4 (socioemotional development, BMI z-scores, weight status), sex, ethnicity (migrant and Indigenous background), area disadvantage, and individual

socioeconomic position. Final models also controlled for the additional stress exposure (bullying victimization for racial discrimination models and vice versa). To explore associations between cumulative exposure to both domains of stress exposure and each health outcome a similar series of multiple regressions were built. For both socioemotional development and BMI z-scores, linear regression was used to obtain estimates of associations with the exposures. For weight status, poisson regression models were used with a robust variance estimator to obtain prevalence rate ratios (PRR) for the exposures as recommended when the outcome is not rare (Zocchetti, Consonni and Bertazzi 1997). While fully interactive versions of these models were unable to be tested due to sample size a more limited strategy was applied by first interacting wave-specific versions of each exposure and second interacting each exposure within waves. Evidence of interactive effects were found for socioemotional development and some evidence for BMI (Appendix Two).

Small amounts of missing data on outcomes slightly reduced the eligible analytic samples for the multiple regression models for socioemotional development (n=2747) and BMI/weight status (n=2644). Data was extracted from the LSAC dataset using the add-on package PanelWhiz (Hahn and Haisken-DeNew 2013). All analyses were conducted in Stata/SE 12 (StataCorp LP 2012) using the 'svy' commands to accommodate sample design characteristics including stratification and sampling weights to account for non-response as noted above. The default setting for the svy command is VCE (robust).

RESULTS

Table 2 shows the prevalence of bullying victimization and of racial discrimination by migration and Indigenous background at W5 and W6. Nearly half (45%) of Indigenous children reported they had been bullied at one time point (either W5 or W6) and over a quarter (27%) that they had been bullied in both W5 and W6. Racial discrimination was reported by just over a fifth (21%) of Indigenous

children at one time point and by 10% at both time points. Children from visible minorities reported less bullying than all other groups, with approximately a third (34%) reporting bullying at one time point and 17% at both time points, although just over a fifth (21%) reported racial discrimination at one time point and 7% reported racial discrimination at both time points. Combined exposure to both bullying victimization and racial discrimination was also highest among Indigenous children, followed by visible minority children.

<Insert Table 2 about here>

Socioemotional difficulties

Table 3 shows the effects of racial discrimination and bullying victimization on health outcomes. Compared with those reporting no experiences of bullying victimization, those who reported exposure to bullying victimization at one time point (either W5 or W6) had higher socioemotional difficulties scores (SDQ) at W6 by 0.58 (95% confidence interval (CI) 0.29, 0.88) points after adjusting for socio-demographics and prior socioemotional difficulties at W4, and those exposed to bullying victimization at both time points had increased SDQ scores at W6 by 1.25 points (95% CI 0.84, 1.66). These associations remained strong after also adjusting for racial discrimination experiences (1.18, 95% CI 0.76, 1.6) (see Table 3).

<Insert Table 3 about here>

There was no evidence of difference in SDQ score at W6 between those reporting no experiences of racial discrimination compared to those reporting racial discrimination at one time point, although SDQ scores at W6 were marginally higher for the latter group (0.35 points higher, 95% CI -0.11, 0.81). While exposure to racial discrimination at both times points increased SDQ scores at W6 by

1.3 points (95% CI 0.2, 2.4), these associations no longer remained after adjusting for bullying victimization (Table 3).

Greater exposure to events over time was associated with incrementally higher SDQ scores. Respondents with exposure to both bullying victimization and racial discrimination at one time point and exposure to a further 1 event at a second time point had SDQ scores 1.21 points higher (95% CI 0.4, 2.03), and those reporting 2 events at 2 time points had SDQ scores 2.68 points higher (95% CI 1.36, 4.00) than those not reporting any exposure.

BMI

There was no evidence of higher BMI z-scores among respondents who reported exposure to bullying victimization at one or at two time points compared with respondents who reported no experiences of bullying victimization after adjusting for covariates. There was some evidence that those who reported exposure to racial discrimination at two time points had a BMI z-score 0.14 points higher (95% CI -0.01, 0.28) compared to those with no exposure, but there was no evidence of an association after adjusting for bullying victimization. Those reporting 2 events at 2 time points had BMI z-scores 0.19 points higher (95% CI 0.02, 0.36) compared to those reporting no exposure, although there was no evidence of an association between lower levels of bullying victimization and racial discrimination with BMI z-scores.

Weight status

Compared with respondents who reported no experiences of bullying victimization, those reporting exposure to bullying victimization at one time point (PRR 1.13, 95% CI 1.0, 1.31) had increased risk of overweight/obesity, in adjusted models. Compared with respondents who reported no exposure to racial discrimination, those reporting racial discrimination at one time point (PRR 1.14, 95% CI 1.0, 1.31) also had increased risk of overweight/obesity in adjusted models. Those reporting both bullying

victimization and racial discrimination at one time point (2 events at one time point) were at increased risk of overweight/obesity (PRR 1.33, 95% CI 1.09, 1.63), and those reporting 2 events at 2 time points were at increased risk (PRR 2.05 (1.42, 2.96) of overweight/obesity compared to those reporting no exposure to either stressor.

DISCUSSION

This study aimed to explore the association between cumulative exposure to racial discrimination and bullying victimization on the health of adolescents in Australia. Findings document that cumulative experiences of racial discrimination and bullying victimization, over time and across stressors, have detrimental effects on both mental and physical adolescent health.

Indigenous adolescents reported the highest levels of each stressor – bullying victimization and racial discrimination - at each time point and across time points. Combined exposure to both stressors was also highest among Indigenous adolescents compared to their peers. These findings are consistent with Australian (Priest et al. 2016) and global (Anderson 2016) data that show indigenous populations experience some of the highest levels of marginalization in the world. This study also found that adolescents from Visible Minority backgrounds reported lower levels of bullying at each time point than their peers with Australian born and Anglo-Euro born parents. This patterning of exposure by Indigenous status and ethnicity is consistent with previous cross-sectional analyses in Australia (Priest et al. 2016) and with international studies where findings are mixed regarding whether adolescents from migrant backgrounds experience less or more bullying than their non-migrant peers, for example in the UK (Tippett, Wolke and Platt 2013), Netherlands (Tolsma et al. 2013), and Canada (Hoglund and Hosan 2013). More work is needed to understand these findings both in Australia and internationally, including more detailed disaggregation of bullying data by country of origin, migration experience, and interactions between ethnicity and nativity, as well as qualitative and quantitative work to explore conceptulisations and measurement of bullying across groups. It is

highly plausible that understandings of bullying vary across migrant and ethnic groups, as well as beliefs about what behaviours can and should be reported.

In contrast, while visible minority adolescents reported less bullying than their majority peers, at each time point and across both time points they reported racial discrimination at similar levels to those from Indigenous backgrounds, and their combined exposure to both racial discrimination and bullying was second only to Indigenous adolescents. This reinforces the ongoing need to pay attention to racial discrimination as a key influence on minority youth development (Garcia Coll et al. 1996).

Bullying victimization and racial discrimination experiences each were found to have an independent and incremental relation with socioemotional development, with greater exposure to each of these stressors associated with higher SDQ scores after accounting for prior socioemotional development. Exposure to each of these stressors was also independently associated with increased risk of overweight/obesity although while these associations remained strong after adjusting for the additional stressor (bullying victimization in models examining racial discrimination, and vice versa) for those reporting stressor exposure at one time point, they did not for those reporting stressor exposure at two time points. This is in contrast to accumulative risk frameworks and findings from the UK showing a dose-response association between childhood bullying victimization and overweight at 18 years, with those chronically bullied showing the strongest associations (Baldwin et al. 2016). One plausible explanation for this is that a longer latency period between stressor exposure and observable effects on overweight/obesity risk is required (Shonkoff, Boyce and McEwen 2009), particularly given that in this study, the second time point of stressor exposure and overweight/obesity were measured concurrently. Nonetheless, these findings do reinforce prior conceptual (Killen, Mulvey and Hitti 2013) and empirical work (Priest et al. 2016) suggesting that bullying victimization and racial discrimination do appear to be distinct risk factor exposures for adolescents, each with substantive consequences for their mental and physical health consequences.

A cumulative, incremental association was found between combined experiences of racial discrimination and bullying victimization and social emotional development, consistent with prior work using the accumulative risk model that shows repeated, multiple risk-factor exposure is more detrimental to development than single exposure (Evans, Li and Whipple 2013). In this study, children who reported repeated exposure to both racial discrimination and bullying victimization over time had an increase in socioeomotional difficulties of 2.68 points, compared with their non-exposed peers. In the Australian youth population the upper limit of the normal range for the parent-reported social and emotional total difficulties score as used in this study is 13 for boys and 12 for girls, with the mean (SD) 8.45 (5.84) for boys and 7.78 (5.94) for girls (Mellor 2005). The 2.68 point increase in socioemotional difficulties observed in this study to be associated with repeated exposure of bullying victimization and racial discrimination is close to half of a standard deviation of the mean total difficulties score in the Australian youth population and thus likely to have substantial clinical impact. Socioemotional difficulties in adolescence not only have substantial impact on young people, their peers and families during in adolescence, they often persist and have a sustained effect on later health, education, social and employment outcomes for adults and on the health of their children (Sawyer et al. 2012). Identifying and addressing key factors contributing to socioemotional difficulties in adolescence is thus an important public health priority with high potential to influence life trajectories across multiple domains.

Across levels of combined exposure, evidence of a cumulative, incremental association between combined experiences of racial discrimination and bullying victimization and BMI z-score and overweight/obesity was less consistent than for social emotional difficulties, with no evidence of association found for single risk factor exposure. However, combined exposure to both risk factors at a single time point, and repeated combined risk factor exposure across both time points, were each strongly associated with risk of overweight/obesity, and the latter also with BMI z-score. Children

who reported repeated occurrences of racial discrimination and bullying victimization over time had an increased BMI z-score of 0.19 points, and twice the risk of overweight/obesity than those with no exposure. Again this is consistent with multiple risk-factor accumulated risk approaches, suggesting the combined impact of both of these two stressors may be far more harmful than exposure to one risk factor in isolation, with repeated exposure to both more harmful than exposure at one time point and those experiencing this level of stress exposure experiencing double the risk of overweight/obesity compared to non-exposed.

However, findings that in some cases lower levels of exposure were not associated with BMI z-score and overweight/obesity does not eliminate the possibility that such levels of exposure influence these outcomes. Rather, as mentioned previously, this is consistent with literature that suggests effects of stressors may be more immediate on mental health outcomes while onset of poor physical health may be delayed due to longer latency periods (Shonkoff, Boyce and McEwen 2009). Studies incorporating immune and inflammatory biomarkers of disease risk are thus an ongoing priority to examine associations and potential mechanisms by which cumulative experiences of racial discrimination, both in isolation and in combination with other stressors such as bullying victimization, influence physical health outcomes such as overweight/obesity .Emerging evidence from studies with African Americans in the U.S. shows racial discrimination experiences are associated with inflammation and blood pressure among 10-15 year olds (Goosby et al. 2015) and with inflammation (Brody et al. 2015), allostatic load (Brody et al. 2014) and epigenetic aging (Brody et al. 2016) among late adolescents. Several bullying victimization studies also show associations between childhood victimization and inflammation and obesity in midlife (Takizawa et al. 2015) and increases in chronic inflammation from 19-21 years (Copeland et al. 2014).

Findings of this present study suggest that cumulative combined exposure to racial discrimination and bullying victimization is relevant to both children's socioemotional and physical health

outcomes, and that repeated exposure to these stressors has potential for significant harmful effects. As highlighted by the integrative minority youth model and the developmental intergroup framework, a focus only on general bullying victimization without also addressing racial discrimination is likely to miss key stressors and determinants of socioemotional development and physical health for adolescents from stigmatized racial ethnic backgrounds, and will also likely under-estimate the stressor burden they experience.

Patterns of exposure to each stressor over time documented in this study shows Indigenous children and adolescents, and those from visible minority backgrounds, each experience the greatest burden of stressor exposure. It thus follows that it is these groups that experience most of the negative mental health impacts of cumulative combined stressor exposure as found in this study. Detailed sub-group analysis by ethnic groups, as well as quantification of the effects of cumulative stressor exposure on inequalities in mental and physical health experienced by these groups, is needed in future studies. More work is needed across populations and contexts with detailed knowledge of patterns of individual stressors and cumulative stress over time limited for children and adolescents from racial ethnic minority, Indigenous and migrant backgrounds, as well as the ways in which racial discrimination and other stressors relevant to their lives independently and in combination cluster, accumulate and influence their health over time (Priest et al. 2016; Slopen et al. 2016).

Strengths of this study are the population representative longitudinal data, consideration of cumulative bullying and racial discrimination exposure, and the inclusion of both socioemotional and physical health outcomes. The use of adolescent self-report of bullying and racial discrimination experiences, and of parent reported socioemotional difficulties also avoids issues of dependent misclassification that can be associated with subjective, self-report outcomes. While a strength of this study is the use of longitudinal data, including accounting for prior health in analyses, some of the measures of racial discrimination and bullying exposure are contemporaneous with the health

outcomes (W6). However, while the association with the outcomes will be stronger for these exposures, longitudinal studies show that racial discrimination and bullying precede poor health making reverse causation of limited concern.

This study is not without limitations. As noted in our methods it was not possible to elucidate questions regarding timing of stressor exposure within these current data. This limited the capacity of this study to fully examine the question of cumulative exposure although the approach used in this current study is consistent with previous work on cumulative discrimination (Wallace, Nazroo and Becares 2016). The interactive tests using a more limited approach show statistical evidence of interaction and support the need to study the cumulative and joint exposure to these negative stressors in future research. Timing, as well as intensity, chronicity and accumulation of stressor exposure remain priorities for future research in this area. As is common in longitudinal studies, participant drop out and non response resulted in missing data. The use of longitudinal survey weights within models accounts for non-response bias due to attrition (Norton and Monahan 2015). We acknowledge this may not fully address bias if those who dropped out had different relationships between exposure and outcomes. Regarding missing data from the eligible sample, there was <5% missing for the exposure measures, i.e. discrimination and bullying, and multiple imputation is considered to provide little gain when there is <5% missing (Lee et al. 2016). LSAC did not ask respondents about exposure to racial discrimination or bullying victimization over their lifetime, nor did it include measures of vicarious experience by carers and family members. A small but growing body of work shows such vicarious exposure is important for children's socioemotional wellbeing (Becares, Nazroo and Kelly 2015), obesity (Kelly, Becares and Nazroo 2013), childhood illnesses (Priest et al. 2012) as well as for adolescent mental health outcomes (Benner and Wang 2016; Ford et al. 2013), and we were not able to assess these experiences in the present analyses. This means that the associations reported here are likely an underestimation of the harm of racial discrimination and bullying victimization on adolescent health. LSAC also changed the measure of bullying victimization from Wave 5 to Wave

6 which may have influenced the reported prevalence of exposure to this stressor. The measure of racial discrimination only included three general items, none of which explored the range of circumstances and places in which children and adolescents may experience discrimination, or the sources or forms of discrimination they experienced, and it is not possible to determine whether discrimination experiences were at an interpersonal or institutional level, or from peers, adults or across all of these domains. Further studies using more detailed measures are needed to investigate this further. The time frame for bullying victimization and racial discrimination exposure was different, which may have also influenced prevalence of these experiences. The lack of self-reported ethnicity data and reliance on parent country of birth as a proxy is also a limitation, with children born to second or third generation migrants not captured by this categorization. Although a nationally representative study, the relatively small number of Indigenous and visible minority participants limits power and capacity for more detailed subgroup analysis. The Indigenous sample in this study is not representative of the Australian Indigenous youth population, particularly those living in remote areas, nor was the study designed to do so (Hunter 2008); Indigenous participants in this study are likely living in urban and regional areas where non-Indigenous people are the greater proportion of the population. Further studies that over-sample children from Indigenous and visible minority backgrounds across a range of socioeconomic experiences, geographical areas, relative proportion of Indigenous and migrant community members, and migration histories are thus needed.

Conclusions

This study provides novel evidence regarding the combined, cumulative effects of racial discrimination and bullying victimization on the health of adolescents using a large population based study and shows that combined, cumulative exposure to racial discrimination and bullying victimization significantly worsen socioemotional difficulties and risk of overweight/obesity. It shows how repeated exposure to each of these stress exposures over time influences the

socioemotional difficulties, BMI z-scores and weight status of Australian adolescents. Findings reinforce that bullying victimization and racial discrimination are each distinct risk factor exposures for adolescents with substantive health consequences, and that focusing on general bullying victimization without also addressing racial discrimination is likely to miss a key stressor and health determinant for adolescents from stigmatized racial ethnic backgrounds.

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Table 1
Descriptive statistics of adolescents' characteristics at Waves 4 and 6 of the LSAC K-Cohort[*]

	Weighted % (95% CI)
Sex	
Male	51.1 (49.5, 52.7)
Female	48.9 (47.3, 50.5)
Country of Birth/Indigenous Status	
Australian born %	61.1 (59.1, 63)
Anglo/Euro %	17 (15.6, 18.5)
Visible minority %	19.3 (17.8, 21.0)
Indigenous %	2.6 (2.1, 3.4)
Household type	
Two parent household %	81.9 (80.6, 83.1)
Single parent household %	18.1 (16.9, 19.4)
Household income (AUD)	
$1-$799/week %	11.9 (10.8, 13.2)
$800-$1499 %	24 (22.4, 25.7)
$1500-$1999 %	19.7 (18.4, 21.1)
$2000 or more %	44.4 (42.0, 46.8)
Parental education	
At least one parent completed high school %	71.4 (69.5, 73.3)
No parent completed high school %	28.6 (26.7, 30.5)
Area disadvantage	
Quintile 1 %	19.6 (16.4, 23.2)
Quintile 2 %	19.3 (16.4, 22.6)
Quintile 3 %	21.2 (17.9, 24.8)
Quintile 4 %	19.6 (16.3, 23.3)
Quintile 5 %	20.4 (16.9, 24.3)
BMI – score Wave 4 Mean (sd)	0.35 (0.02)
Weight status Wave 4	
Not overweight or obese %	74.2 (72.6, 75.7)
Overweight or obese %	25.8 (24.3, 27.4)
BMI – score Wave 6 Mean (sd)	0.36 (0.03)
Weight status Wave 6	
Not overweight or obese %	73.2 (71.7, 74.7)
Overweight or obese %	26.8 (25.3, 28.3)
Socio-emotional development Wave 4 SDQ Mean (sd)	7.9 (0.11)
Socio-emotional development Wave 6 SDQ Mean (sd)	7.1 (0.11)

**Demographic information is from Wave 4 only*

Table 2

Prevalence of Racial Discrimination and Bullying Victimization at Waves 5 and 6 Longitudinal Study of Australian Children (LSAC) K-Cohort 2012-2014 by parent country of birth and Indigenous status

	Australian born	**Anglo/Euro**	**Visible Minority**	**Indigenous**
Total	**% (95% CI)** 61.1 (59.1 63.0)	**% (95% CI)** 17 (15.6 18.5)	**% (95% CI)** 19.3 (17.8 21)	**% (95% CI)** 2.6 (2.1 3.4)
		Wave 5		
Any Bullying	54.8 (52.7 56.8)	56.9 (52.6 61.0)	43.3 (38.9 48.9)	69.4 (57.3 79.4)
Any Racial Discrimination	8.2 (7.1 9.6)	8.4 (6.3 11.1)	18.2 (14.7 22.3)	25.0 (16.4 36.2)
		Wave 6		
Any Bullying	30.7 (28.7 32.8)	29.8 (25.9 34.1)	26.9 (22.8 31.5)	36.9 (26.2 49.1)
Any Racial Discrimination	5.7 (4.7 6.8)	7.6 (5.8 9.9)	17.7 (14.3 21.7)	21.2 (13 32.6)
		Waves 5 and 6		
Bullying				
No exposure	37.7 (35.8 39.6)	37.2 (33 41.6)	48.9 (44.3 53.4)	28.0 (18.9 39.4)
1 time point	41.8 (39.7 43.8)	41.6 (37.3 46)	33.9 (29.4 38.7)	45.3 (34.6 56.5)
2 time points	20.6 (18.8 22.4)	21.2 (17.8 25)	17.3 (14 21.1)	26.7 (17.7 38.2)
Racial Discrimination				
No exposure	88 (86.5 89.4)	85.5 (82.4 88.2)	72 (67.7 76)	68 (57 77.3)
1 time point	10.5 (9.2 11.9)	13.5 (11 16.4)	21.1 (17.7 25)	21.3 (13.8 31.5)
2 time points	1.5 (1 2.2)	1 (0.5 2.2)	6.8 (4.9 9.5)	10.7 (5.2 20.7)
Combined Cumulative Exposure				
No exposure (ref)	35.2 (33.3 37.2)	34.2 (30.3 38.3)	41.8 (37.3 46.4)	25.3 (16.6 36.6)
1 event at 1 time point	39.2 (37.2 41.2)	38.4 (34.2 42.7)	29.5 (25.1 34.4)	32.0 (22.3 43.5)
2 events at 1 time point	4.6 (3.8 5.5)	5.7 (4.2 7.8)	9.3 (6.9 12.5)	12.0 (6.5 21.2)
Bullying at 2 time points	16.1 (14.5 17.9)	16.0 (13.2 19.3)	7.0 (5.0 9.8)	12.0 (6.7 20.5)
Discrimination at 2 time points	0.0 (0.0 0.0)	0.0 (0.0 0.0)	0.7 (0.2 2.1)	1.3 (0.2 9)
2 events at 1 time point 1 event at 1 time point	3.9 (3.2 4.9)	5.2 (3.8 7.2)	6.8 (4.8 9.7)	10.7 (5.6 19.3)
2 events at 2 time points	1 (0.6 1.6)	0.5 (0.2 1.5)	4.8 (3.1 7.2)	6.7 (2.9 14.6)

Table 3 *Associations between accumulation of Bullying and Racial Discrimination reported at Waves 5 and 6 with Socioemotional difficulties at Wave 6 in LSAC-K 2010-2014*

	Model 1	**Model 2**	**Model 3**
	b (95% CI)	**b (95% CI)**	**b (95% CI)**
		Socioemotional difficulties	
Bullying			
No exposure[#]			
1 time point	1.56 (1.15 1.98), p<0.001	0.58 (0.29, 0.88) p<0.001	0.56 (0.27, 0.86) p<0.001
2 time points	3.17 (2.63, 3.71) p<0.001	1.25 (0.84, 1.66) p<0.001	1.18 (0.76, 1.6) p<0.001
Racial Discrimination			
No exposure[#]			
1 time point	1.27 (0.61, 1.93) p<0.001	0.35 (-0.11, 0.81) p=0.13	0.17 (-0.29, 0.62) p=0.48
2 time points	3.37 (1.59, 5.15) p<0.001	1.30 (0.2, 2.4) p=0.02	0.83 (-0.27, 1.93) p=0.14
Combined Cumulative Exposure			
No exposure[#]			
1 event at 1 time point	1.39 (0.97, 1.8) p<0.001	0.51 (0.2, 0.81) p=0.001	
2 events at 1 time point	2.22 (1.21, 3.23) p<0.001	0.78 (0.18, 1.38) p=0.01	
Bullying at 2 time points	2.71 (2.12, 3.3) p<0.001	1.08 (0.63, 1.53) p<0.001	
2 events at 1 time point 1 event at 1 time point	3.66 (2.58, 4.75) p<0.001	1.21 (0.4, 2.03) p=0.004	
2 events at 2 time points	6.13 (3.87, 8.39) p<0.001	2.68 (1.36, 4.0) p<0.001	

Model 1 crude unadjusted; Model 2 adjusted for household composition parental education household income area level disadvantage child sex and ethnicity (parent country of birth and Indigenous status) prior socioemotional difficulties at W4; Model 3 adjusted for 'Any' Bullying (model for Racial Discrimination) or Racial Discrimination (model for Bullying); [#]Reference category: No exposure; [*]Reference category: normal weight.

Table 4 *Associations between accumulation of Bullying and Racial Discrimination reported at Waves 5 and 6 with BMI z-score at Wave 6 in LSAC-K 2010-2014*

	BMI z score		
Bullying			
No exposure			
1 time point	0.02 (-0.07, 0.11) p=0.658	-0.01 (-0.07, 0.05) p=0.726	-0.02 (-0.07, 0.04) p=0.61
2 time points	0.14 (0.02, 0.26) p=0.019	0.06 (-0.03, 0.16) p=0.184	0.05 (-0.05, 0.15) p=0.33
Racial Discrimination			
No exposure			
1 time point	0.11 (0 0, 0.23) p=0.05	0.05 (-0.02, 0.13) p=0.14	0.05 (-0.03, 0.12) p=0.20
2 time points	0.31 (0.08, 0.53) p=0.01	0.14 (-0.01, 0.28) p=0.06	0.11 (-0.04, 0.26) p=0.15
Combined Cumulative Exposure			
No exposure			
1 event at 1 time point	0.02 (-0.08, 0.11) p=0.73	0 (-0.07, 0.06) p=0.92	
2 events at 1 time point	0.15 (-0.03, 0.33) p=0.11	0.01 (-0.09, 0.11) p=0.80	
Bullying at 2 time points	0.12 (-0.03, 0.27) p=0.11	0.04 (-0.07, 0.15) p=0.45	
2 events at 1 time point 1 event at 1 time point	0.13 (-0.04, 0.29) p=0.13	0.1 (-0.03, 0.23) p=0.12	
2 events at 2 time points	0.49 (0.21, 0.77) p=0.001	0.19 (0.02, 0.36) p=0.03	

Table 5 ***Associations between accumulation of Bullying and Racial Discrimination reported at Waves 5 and 6 with Weight Status at Wave 6 in LSAC-K 2010-2014***

	PRR (95% CI)	**PRR (95% CI)**	**PRR (95% CI)**
	Weight status (Overweight/Obese)*		
Bullying			
No exposure			
1 time point	1.2 (1.03, 1.38) p=0.02	1.14 (1.01, 1.29) p=0.03	1.13 (1.0, 1.27) p=0.05
2 time points	1.25 (1.06, 1.49) p=0.01	1.16 (1.01, 1.33) p=0.03	1.13 (0.98, 1.29) p=0.09
Racial Discrimination			
No exposure			
1 time point	1.15 (0.95, 1.38) p=0.14	1.17 (1.02, 1.34) p=0.02	1.14 (1 1,.31) p=0.05
2 time points	1.48 (1.05, 2.08) p=0.02	1.17 (0.89, 1.52) p=0.26	1.11 (0.84, 1.46) p=0.46
Combined Cumulative Exposure			
No exposure			
1 event at 1 time point	1.15 (0.98, 1.35) p=0.08	1.11 (0.96, 1.27) p=0.15	
2 events at 1 time point	1.42 (1.09, 1.84) p=0.01	1.33 (1.09, 1.63) p=0.01	
Bullying at 2 time points	1.18 (0.97, 1.45) p=0.10	1.11 (0.95, 1.3) p=0.17	
2 events at 1 time point 1 event at 1 time point	1.18 (0.88, 1.58) p=0.28	1.22 (0.9,5 1.57) p=0.11	
2 events at 2 time points	1.32 (0.99, 1.78) p=0.06	2.05 (1.42, 2.96) p<0.001	